

UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Robert E. Higashi et al.
Serial No.: 10/750,581
Filed: December 29, 2003
For: MICRO FUEL CELL
Docket No.: H0005015-1100.1237101

Confirmation No.: 8573
Examiner: Alix Echelmeyer
Group Art Unit: 1745
Customer No.: 90545

SUPPLEMENTAL DECLARATION UNDER 37 C.F.R. § 1.131

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

CERTIFICATE OF ELECTRONIC TRANSMISSION

I hereby certify that this paper is being electronically transmitted to the United States Patent and Trademark Office on the date shown below.

Lynn Thompson 3-11-10
Lynn Thompson Date

We, Robert E. Higashi, Khanh Q. Nguyen, Karen M. Newstrom-Peitsos, Tom R. Rezachek, and Roland A. Wood, as the inventors of the claimed invention of the above-identified application, declare as follows:

This Declaration is to establish completion of the invention in the above-identified application in the United States at a date prior to April 30, 2003.

Facts and Documentary Evidence

All work on the invention included in the above-identified application was completed in the United States.

The invention of the above-identified patent application was completed prior to April 30, 2003. As evidence of this, attached hereto as Exhibit 2 are true and accurate copies of certain pages from a report entitled "AMPGen: Active Micro Power Generator", with dates removed. From the dates set forth on the AMPGen report (which have been redacted from the attached

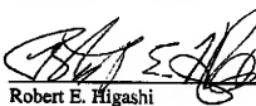
U.S. Application No. 10/750,581
Declaration under 37 C.F.R. §1.131

copy), we can tell that the fuel cell shown in FIG. 9 was made and tested prior to April 30, 2003. The fuel cell shown in FIG. 9 was made in accordance with the invention and was tested and found suitable for its intended purpose as shown in FIG. 10. The report shows that the invention of the above-identified patent application was completed prior to April 30, 2003.

We hereby declare that all statements made herein are of my own knowledge and are true and all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Respectfully submitted,

Date: 3/9/10



Robert E. Higashi

Date: 3/9/10

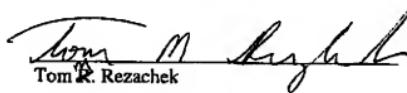


Khanh Q. Nguyen

Date: _____

Karen M. Newstrom-Peitsos

Date: 3/9/10



Tom R. Rezacheck

Date: _____

Roland A. Wood

Exhibit 2

AMPGen: Active Micro Power Generator

Contract Number F33615-01-C-2171

Quarterly Status Report for the Period ending

CDRL Data Item A007

Preparation Date:

Prepared By:

Honeywell Laboratories
12001 State Highway 55
Plymouth, MN 55441-4799

Andrew Wood, Principal Investigator

Phone 763-954-2799 Fax 763-954-2504 andrew.wood2@honeywell.com

For:

Air Force Research Laboratory
2310 8th Street
Wright Patterson AFB, OH 45433-7801

Dr. R A Wood
Principal Investigator

Dr. Cleo Cabuz
MicroDevices Laboratory Manager

UNCLASSIFIED

Distribution authorized to U.S. Government Agencies only. Other requests shall be referred to:

Air Force Research Laboratory
2310 8th Street
Wright Patterson AFB, OH 45433-7801

(*) This report also constitute a semiannual report for the period ending

- Ambient temperature was 28 ± 0.5 °C and relative humidity 49 ± 2 %.
- 99.999 % pure non-humidified hydrogen was used.

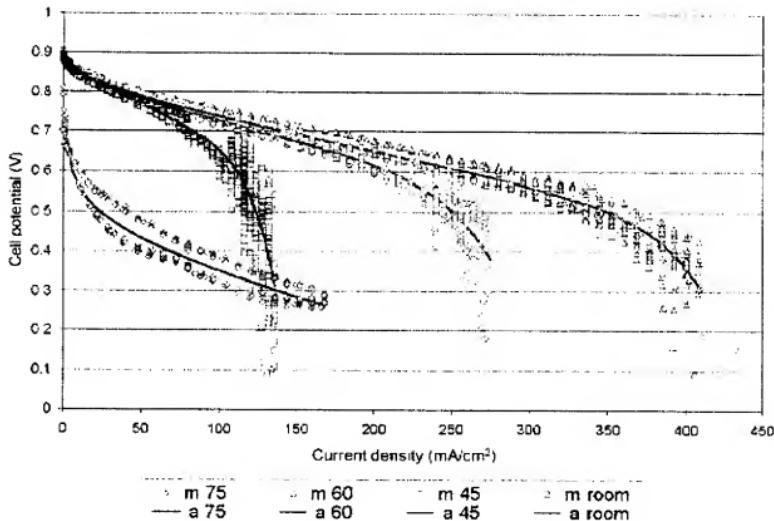


fig 8. experimental data on fuel cell operation with dry hydrogen.

At a temperature of -10C and -25C dew point the conductance of Nafion has been measured (T Reitz communication) to be $1.8\text{mS}/\text{cm}$. Thus a Nafion PEM 1 mil thick and 1mm^2 area would have an electrical resistance of $1/(1.8\text{e}-3 * 25\text{e}-4/0.01) = 140$ Ohms, and a current density of $10\text{mA}/\text{cm}^2$ would produce an Ohmic voltage drop across the PEM of 14mV , a negligible voltage loss. Thus the prospects are quite encouraging that AMPGen modules will operate well below the freezing point of water.

To obtain practical experience with fuel cells operating with dry hydrogen at low temperatures, a fuel cell was constructed, shown in fig 9. The PEM was Nafion™ lot number W37385AB, 40μm thickness, 2mm diameter, with carbon electrodes with $0.3\text{mg}/\text{cm}^2$ Pt, cost 55 cents per cm^2 , supplied by Ion Power Inc (www.ion-power.com). The electrodes were aluminized mylar with an adhesive surface. One side of the fuel cell

was exposed to a slowly flowing stream of dry hydrogen, and the other side was open to the laboratory room air. The fuel cell produced an open circuit voltage of about 0.75V and maintained that for a period of a few days, the duration of the test. The V-I characteristic is shown below. It can be seen that the goal current density (about 10mA/cm²) was achieved.



fig 9 prototype fuel cell (since PEM cell 2mm diameter). Dry hydrogen flows slowly along the gas line which leads past one side of the PEM. The other side of the PEM (dark circular area) is open to laboratory air.

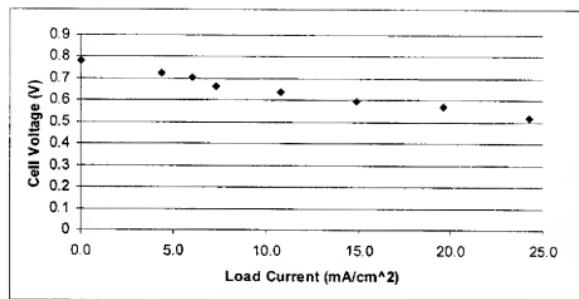


fig 10. Measured V-I characteristic of the fuel cell of fig 5. AMPGen requirement is about 0.6V at about 10mA/cm².